Motor System Maintenance: A Best-Practice Approach

Nobody plans to fail, but often they fail to plan, and when a motor fails in an industrial setting, it is often the first of two failures. The second is the (usually panicked) choice of a replacement for the failed motor. Given the fact that motor-driven equipment accounts for 64 percent of industrial electrical use in the U.S., and about 50 percent of the *world's* overall electricity use, developing a comprehensive plan for motor maintenance and management is a must for industrial facilities.

Good motor-maintenance practices can improve motor efficiencies by up to 10 percent. Economic return on the significant investment that drivepower users make in efficient motor systems is predicated on those systems providing reliable and optimal service for many years after the first installation—performance that can only be achieved with consistent and thorough maintenance.

The information provided by a thorough maintenance program is a necessary precursor to intelligently examining a host of issues, including motor loading and sizing, retrofit possibilities, and opportunities for variable-speed operation.

Replacement-Motor Selections

Making good choices when replacing worn or obsolete motors is extremely important. The financial and environmental ramifications of making bad motor decisions can be huge and, given that motors may remain in service for 20 or 30 years, long lasting. The cost of energy used by motors is much higher than their initial capital cost. In fact, capital costs are only 1 to 3 percent of a typical large motor's life-cycle costs. Even very small differences in operating efficiency can thus outweigh any differences in initial costs.

Motor-Maintenance Tools

Many tools are available to perform quality preventive maintenance of individual motors. Basic motor-maintenance activities include monitoring, lubricating, cleaning, adjusting belt and chain tensions, and periodically checking and replacing rapidly wearing parts such as brushes, belts, sheaves, and chains as well as longer-lasting components such as bearings and gears. These fundamental tasks should be performed weekly or monthly.

Beyond the frequent and fundamental maintenance tasks, a consistent and comprehensive motor-maintenance program should also include installation checklists. Vibration and noise measurement analysis, as well as precision alignment of the motor, coupling system, and load should all be checked whenever a new or rebuilt motor is installed, adjusted, or moved. To ensure that the quality of power delivered to the motor is adequate, harmonic levels should be checked several times per year—especially when new equipment is added (such as capacitors or adjustable-speed drives)—and phase voltage unbalance measurements should be given the same frequency of attention.

Of the many components that make up an effective motor-maintenance program, motor circuit analysis (MCA) systems hold great promise for identifying motor problems before they result in expensive failures. MCA systems offer additional benefits, including improved reliability, productivity, and energy efficiency of the motor system. MCA measures the absolute and relative resistance, inductance, and capacitance of motor circuits and windings. With these measurements, and comparisons with previous measurements, MCA can assess the health and failure risk of individual motors.

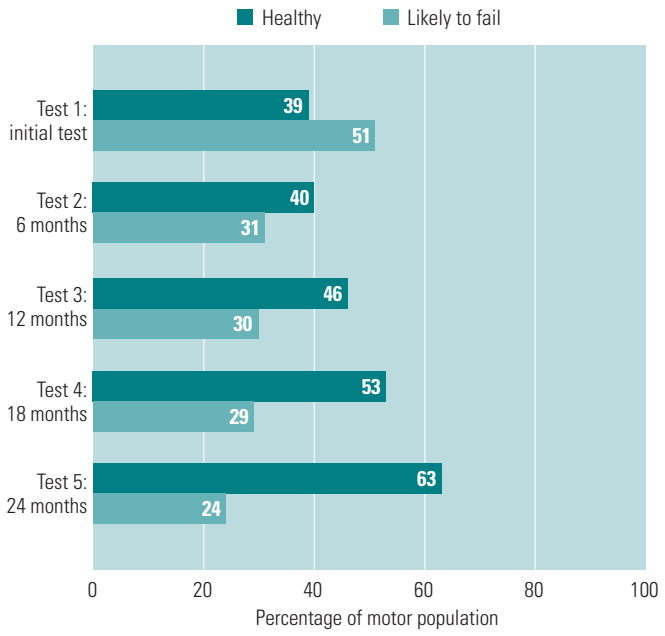
Case Study: Motor Circuit Analysis at a Northwestern U.S. Industrial Facility

An industrial facility in the Northwest that has more than 1,000 motors in service, ranging from under 1 horsepower (hp) to 300 hp, began using MCA. The facility performed several hundred MCA tests at each regularly scheduled shutdown (every six months). Although the facility had been using other diagnostic techniques for finding motor problems, including extensive use of infrared imaging, the MCA tests found that more than half of the tested motors had at least one life-threatening imbalance or excessive resistance. This diagnosis led to repairs for 219 motors suffering from resistive hot spots and for another 14 that had inductive imbalances. Subsequent MCA tests included more motors and identified more serious problems.

In the two years between the first and fifth test, the percentage of healthy motors increased from less than 40 percent to more than 60 percent (**Figure 1**). Over this same period, motor repair costs in the facility dropped precipitously due to improved motor health and maintenance. Additionally, the company attributes more than $250,000 in reduced energy consumption (representing about 10 megawatt-hours) over three years to improved motor performance—an estimate the company considers conservative.

Figure 1: Results from ongoing MCA testing

Consistent motor circuit analysis (MCA) testing and follow-up can dramatically improve the health of motor systems. Results are from repeated testing of approximately 1,000 motors.



Source: Predictive Maintenance Ltd.

Benefits of Motor Maintenance

Significant energy and cost savings can result from a thorough motor-maintenance program. The increased maintenance costs are small compared with these potential savings.

In addition to yielding energy savings, improving motor maintenance also increases motor system reliability and productivity, leading to reduced downtime caused by failed motors. The cost savings from reduced downtime, though difficult to estimate, are likely to be much greater than the energy cost savings.

Resources

Motor Systems

Motor Decisions Matter

http://www.motorsmatter.org

Recognizing the importance of preventive maintenance and proper replacement-motor selection, a broad coalition—including the National Electrical Manufacturers Association (NEMA), the Electrical Apparatus Service Association, the Consortium for Energy Efficiency, the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency, and numerous electric utilities and motor manufacturers—has coalesced to develop and promote a campaign dubbed "Motor Decisions Matter," which is designed to shed light on the importance of these decisions and to provide the industry with tools to improve planning for motor reliability and efficiency.

E SOURCE *Drivepower Technology Atlas*

http://www.esource.com/members/resources/core_techatlas.asp

(E SOURCE members only) Go to the E SOURCE *Drivepower Technology Atlas*, Chapter 12: "Motor System Maintenance" (October 1996) for more information about motor system maintenance and motor circuit analysis.

DOE's Office of Industrial Technologies: Best Practices
http://www.oit.doe.gov/bestpractices/motors

The DOE's Best Practices program helps manufacturers to identify energy and process efficiency opportunities within their plants. The "Motors Best Practice" page contains training information, software tools, and publications that can be read, downloaded or ordered from the Office of Industrial Technologies Clearinghouse.

NEMA Premium™ Efficiency Electric Motors Program
http://www.nema.org/premiummotors

The NEMA Premium energy-efficiency motors program provides energy-efficient products for users and original equipment manufacturers based on a consensus definition of "premium efficiency" and use of the NEMA Premium logo for premium products.

Electrical Apparatus Service Association (EASA)
http://www.easa.com

EASA serves its mechanical apparatus, electrical, and electronic members through consultation, education, and information that promotes the highest standards of performance and ethics for the benefit of the industry as a whole. EASA publishes a wide range of books and articles and maintains a database containing a large variety of motor-winding data.

MCA Technology

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